EXHIBIT B

UNITED STATES DISTRICT COURT

SOUTHERN DISTRICT OF NEW YORK

In Re: Methyl Tertiary Butyl Ether ("MtBE") Products Liability Litigation	MDL No. 1358 Master File C.A. No. 1:00-1898 (SAS)

This document relates to the following cases:

City of New York v. Amerada Hess Corp., et al.

04 Civ. 3417

EXPERT REPORT OF MARCEL MOREAU

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Signature

December 19, 2008

Date

litigations, including *South Tahoe Public Utility District v. Atlantic Richfield Co., et al.* San Francisco Superior Court Case No. 999128; *Communities for a Better Environment v. Unocal Corp., et al.*, San Francisco Superior Court Case No. 997013 and *Dunne, et al. v. Shell Oil Company*, Index #96-13856T, Supreme Court of the State of New York, County of Westchester.

A listing of my publications and the cases in which I have provided deposition and trial testimony is contained in my curriculum vitae which is attached to this report as Appendix A.

I am being compensated for my time at the rate of $255 per hour. No portion of my compensation is contingent upon the outcome of this litigation.

Overview

At the request of plaintiffs, I have been asked to review industry documents and draw on my knowledge and experience in underground storage systems to render opinions concerning the following four topics:

I. What are the components of underground storage systems and how do petroleum releases typically occur from these systems?

II. What is the efficacy of leak detection methods in detecting leaks from underground petroleum storage systems, especially leaks of petroleum containing MtBE?

III. What was the petroleum marketing industry's knowledge concerning the integrity of underground storage systems at the time when gasoline/MtBE mixtures were stored in underground storage systems?

IV. What is the MtBE problem, what did the oil industry know during the 1980's and 1990's about the MtBE problem, and what steps did they take and what warnings did they provide in response to the problem?

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The MtBE Problem

MtBE has chemical properties that are significantly different from most other gasoline constituents. It is much more soluble in water, it is resistant to biodegradation, and it has very low odor and taste thresholds. This means that when gasoline containing MtBE is released into the environment, it will readily dissolve into and flow with the groundwater (because of its high solubility), will migrate long distances from the source (because soil bacteria will not degrade it) and will be readily detected in water supplies by consumers (because of the low odor and taste thresholds). The high solubility and mobility combined with the low odor and taste threshold mean that even very small quantities of gasoline containing MtBE released from a storage system have the potential to cause significant problems with nearby water supplies (see Section II above).

In contrast, ethanol, another compound that can be used as a fuel oxygenate, biodegrades rapidly. For this reason, even though ethanol is completely miscible in water, it does not pose nearly as great a threat to groundwater quality as MtBE. This is because it will be removed from the environment through biodegradation before it can migrate very far from the source of the release.

For most of the twentieth century, the petroleum marketing industry had adopted a rather cavalier attitude towards small volume leaks and spills of gasoline. Small leaks from storage systems, and spills associated with delivery activities, equipment maintenance, and vehicle fueling were accepted as a fact of life. Because the components of traditional gasoline were relatively insoluble and biodegraded fairly readily, these types of spills only rarely caused significant contamination incidents.

The introduction of MtBE into the gasoline, however, meant that these types of spills were suddenly very important. Despite the radical adjustments that needed to be made to attitudes concerning small leaks and spills, the major oil refiners provided no

warnings to fuel distributors, marketers, end users, or equipment service technicians that the old way of doing things was no longer acceptable.

The following chronology presents a few examples of the oil marketing industry's knowledge of the MtBE problem and their response to it. Note that this chronology is intended to provide an overview of these issues. There are many other documents, especially internal company documents, that could be cited to document the oil industry's knowledge of the MtBE problem.

1980 - Rockaway, New Jersey

One of the first documented incidents of MtBE contamination of groundwater occurred in Rockaway, New Jersey in November 1980, only 19 months after MtBE was first commercially produced. A public water supply system 1300 feet from a Shell gasoline station was contaminated with approximately 50-60 ppb of MtBE ("Removing Organics From Groundwater Through Aeration Plus GAC," Ronald J. McKinnon and John E. Dyksen, Journal of the American Water Well Association, May, 1984, Mickelson Tahoe Deposition, 1/13/2000, Exhibit #12). The investigation of this release revealed that MtBE was very soluble and mobile relative to other gasoline constituents, and that it had very low odor and taste thresholds.

1980 – Jacksonville, Maryland

In 1980, Gulf, Amoco, and Exxon were involved with multiple releases of gasoline, some of which contained MtBE at marketing facilities in Jacksonville, Maryland (Anderson deposition in *South Tahoe Public Utility District v. Atlantic Richfield Co. et al.*, 35:3-4, Mickelson deposition in *South Tahoe Public Utility District v. Atlantic Richfield Co. et al.*, 38:18-25, 39:1-3). Ms. Mickelson, an Exxon employee, noted in a 1984 memo that the "…Gulf MtBE plume has not been controlled and migrated over twice the distance of the Exxon BTX (Benzene, Toluene, Xylene) plume which has been halted. We (Exxon) are now facing onerous Federal EPA compliance actions which will add costs to the multimillion dollar incident" (Mickelson deposition in *South Tahoe Public Utility District v. Atlantic Richfield Co. et al.*, Exhibit 5).

In 1984, Ms. Mickelson was asked to evaluate the consequences of adding MtBE to Exxon gasolines. Ms. Mickelson concluded, based on her knowledge of Exxon and Shell's experiences with MtBE releases, that because of MtBE's solubility, low odor and taste thresholds, and difficulty of removal from groundwater, that large scale addition of MtBE to Exxon gasolines would likely increase the number of well contamination incidents by a factor of three and the cost of cleaning up these incidents would increase by a factor of five (ibid.).

1983 The API and MtBE

The American Petroleum Institute (API) is a large, multi-faceted trade organization whose members are involved in all aspects of petroleum production, refining, distribution and marketing. The work of the API is accomplished primarily through numerous committees comprised of representatives from interested member companies. Two of the committees within the API that were concerned with underground storage systems and MtBE were the "Operations and Engineering Committee" (O & E) that dealt with storage system issues, and the "Groundwater Technical Task Force" (GTTF) that was concerned with clean-up issues related to petroleum releases to the subsurface.

One of the functions of the API is to conduct studies and produce reports on issues of concern to its membership. API publications are generally submitted for review by members of relevant committees to ensure quality and consistency with member company policies and viewpoints. It is reasonable to assume that the contents of API publications have been reviewed by representatives of member companies with an interest in the subject.

In 1983, the API published a document entitled "Treatment Technology for Removal of Dissolved Gasoline Components From Ground Water" (Stanley deposition in *South Tahoe Public Utility District v. Atlantic Richfield Co. et al.*, Exhibit 8b) that described the techniques available for removing dissolved gasoline constituents from groundwater. Along with the traditional chemicals of concern (Benzene, Toluene, Xylene or "BTX") the study addressed the efficacy of removal techniques with regard to

MtBE. The document indicated that MtBE would not be effectively removed by carbon filtration, and that air stripping was effective "under certain conditions."

The fact that MtBE was included in this study was an indication that there was some concern from API member companies about this chemical. In addition, the representatives of many, if not all, major oil marketing companies would have had an opportunity to review this document prior to its publication.

June 14, 1984

An internal ARCO Chemical Company memo on this date from B. K. Hoover to S. A. Ridlon summarized a meeting of the API Ad Hoc Committee on MtBE. This meeting included representatives from Shell, Texaco, API, Phillips, ARCO, and ARCO Chemical. This committee was concerned primarily with MtBE toxicological issues, but it was noted that, "MTBE is a possible contaminant of groundwater, especially in association with leaking gasoline storage tanks" (Bates #ARC 035448, p. 1). This committee apparently had some uncommitted funds that they decided to make available to the Environmental Biology and Community Health Committee of API, provided that the money be used to study taste and odor issues specifically associated with MtBE. This memo documents that even among oil industry toxicologists the leaking storage tank problem was recognized, and that human exposure to MtBE via groundwater contamination was considered significant enough to warrant taste and odor studies of MtBE.

1984 – The Fujiwara Study

Japanese law specifies that new chemical compounds cannot be released into the marketplace unless the safety of the chemical has been investigated (Fujiwara, Y., T. Kinoshita, H. Sato, and I. Kojima, 1984, Biodegradation and Bioconcentration of Alkyl Ethers: Yukagatu, v. 33, pp. 111-114). In 1984, Fujiwara et al. published a paper documenting that MtBE was "…difficult to biodegrade" (ibid.). This conclusion was based both on experiments that they conducted and an analysis of the chemical structure of MtBE.

Thus the discovery of MtBE in Maine water samples was purely fortuitous, and came about because we were focused on removing "oil" from the groundwater rather than specific chemicals.

May 23, 1986

On this date, R. J. Hinds of Chevron sent an internal memo to W. R. Leek entitled, "MTBE in Groundwater" (Bates #CHEV 14883). The memo begins, "I've been doing some looking into MTBE in relation to potential groundwater contamination concerns…The more I have been finding out about MtBE, the more interesting it becomes" (ibid.).

The memo goes on to describe the author's findings, including the relatively high water solubility of MtBE, the impracticality of removing MtBE from water with activated carbon, the "moderate" difficulty of using air stripping to remove MtBE from water, and an "…indication that MtBE will migrate more rapidly with the groundwater in the soil" (ibid.). The author suspected that MTBE was "suitably biodegradable," but also noted that little information on biodegradation was available and a more extensive literature search and perhaps some preliminary testing might be in order.

This memo makes it clear that Peter Garrett and myself in Maine were not the only ones concerned about MtBE in groundwater. It also confirms that our observations about MtBE were not unique. Oil industry personnel were finding much the same thing.

June 11, 1986

On this date, Chevron employee D. W. Callahan sent a memo to another Chevron employee, O. T. Buffalow, entitled, "Marketing Environmental Concerns Regarding the Use of MtBE in Mogas (Motor Gasoline)" (Bates # CHEV 14902-03). The memo referenced a cleanup in Maryland where MtBE was a contaminant and an API literature study of MtBE that showed that MtBE had "…several disturbing properties" (ibid.). The "disturbing" properties listed in the memo included relatively high solubility and mobility, low odor and taste thresholds, low rate of biodegradation, and difficulty of removal from water. Mr. Callahan then went on to express concern over the expected

environment, that human exposure to MTBE and release of MTBE to the environment is negligible, that sufficient data exist to reasonably determine or predict that manufacture, processing, distribution, use and disposal of MtBE will not have an adverse effect on health or the environment" (Dominguez deposition in *South Tahoe Public Utility District v. Atlantic Richfield Co. et al.*, Exhibit 13a, emphasis added.)

By 1987, several oil company members of the MtBE Committee had had significant experience with MtBE and were well aware of the ability of small quantities of MtBE to contaminate large quantities of ground water, the low odor and taste thresholds of MtBE, and the difficulties of removing MtBE from ground water. The overall condition of the nation's storage system population had also been evaluated and found to be in serious need of repair (see Section III above). Clearly, in carrying out its mission to represent the interests of MtBE producers and users to EPA, the MtBE Committee was not about to let a few inconvenient facts stand in the way of painting a very rosy picture to the EPA.

1988 - The API Whitewashes the MtBE Issue

In 1988, API published a document entitled, "Alcohols and Ethers - A Technical Assessment of Their Application as Fuels and Fuel Components" (Stanley deposition in *South Tahoe Public Utility District v. Atlantic Richfield Co. et al.,* Volume III, Exhibit #13) Chapter 8 of this document addresses "Groundwater and Toxicity Effects."

A draft of the ground water chapter was written by a contractor for API in 1987 (Stanley deposition in *South Tahoe Public Utility District v. Atlantic Richfield Co. et al.*, Volume III, Exhibit 10). The draft included language which described some of the hazards posed by MtBE to ground water, including rapid percolation into the ground water and the difficulty of removal of MtBE from ground water using carbon filtration and air stripping. The draft also discussed at some length the Maine MtBE paper's findings, and even reproduced a graphic from the paper depicting a ground water plume with MtBE contamination extending beyond the other constituents of gasoline. Members of the API's Groundwater Technical Task Force (GTTF) who reviewed the draft commented that it was inaccurate and presented a "…generally negative attitude towards

oxygenated fuels as a groundwater contaminant" (Stanley deposition in *South Tahoe Public Utility District v. Atlantic Richfield Co. et al.*, Volume III, Exhibit 11).

Curt Stanley of Shell Oil agreed that the document needed work, but his suggestions for changes would have put MtBE in an even less favorable light (Stanley deposition in *South Tahoe Public Utility District v. Atlantic Richfield Co. et al.*, Volume III, Exhibit 12). Mr. Stanley described several key factors omitted from the draft document, including a discussion of oxygenate solubility, the more extensive mitigation efforts required to deal with oxygenated plumes, the difficulty of treating water contaminated with oxygenates, and the low odor and taste thresholds for oxygenates. Mr. Stanley hoped that the presentation of these factors in an API document would result in corporate management gaining a clearer understanding of the "…increased risk posed by oxygenated additives in gasoline" (ibid.).

The Maine paper in 1986 had almost let the cat out of the bag with regard to the behavior of MtBE in the environment, but it could be dismissed by oil company personnel as an unsophisticated analysis by a couple of clueless regulators. Mr. Stanley knew very well that Mr. Garrett, Mr. Lowry, and myself were basically correct in our analysis of MtBE, but he also knew that oil company personnel did not routinely rely on regulators for their technical information. Mr. Stanley realized that a document with the API logo on it, vetted by representatives of all the major players in the oil marketing industry, would have been impossible for corporate managers in the API member companies to ignore. This was why it was crucially important that this document describe fully what was known about MtBE in groundwater.

Instead of taking this opportunity to increase awareness as Mr. Stanley suggested, the GTTF and the API chose to whitewash the issue. The published version of the API document (Stanley deposition in *South Tahoe Public Utility District v. Atlantic Richfield Co. et al.*, Volume III, Exhibit 13) stated that "Only a few incidents of groundwater contamination by oxygenates or blends have been documented...it is not possible at this time to provide a definitive summary of the potential environmental effects of oxygenated fuels." Though the published literature on MtBE and groundwater was indeed scarce, the oil industry experience with MtBE and groundwater by this time had been significant and consistent. Mr. Stanley and many others within the oil industry

knew only too well the trouble that could be caused by releasing gasoline with MtBE into the environment.

1992 - Chevron Recognizes the Risks of Spilling MtBE Gasoline

Chevron embarked on an extensive tank upgrading program throughout most of the 1980's. This program was known internally as the "Tank Improvement Program" (TIP). Information concerning the TIP program was communicated to program coordinators via a series of "TIP Letters." TIP Letter #237, dated August 12, 1991, bore the title "MTBE Effects" (Jessel deposition, Exhibit 12, Bates #CHEV 09564-9567). The letter pointed out the distinctive properties of MtBE, and noted that MtBE was widely used within the Chevron distribution network and that this usage was likely to increase with the recent passage of the federal Clean Air Act. The author thought it "prudent" to pass on information about MtBE to help prioritize sites due for UST upgrades. The "highest concern" was for service stations that might be receiving MtBE gasoline that were not equipped with spill containment manholes. The letter stated that, "The combination of MTBE gasoline being delivered, the lack of spill containment manholes, and shallow groundwater could be tremendously expensive for us in the long run. As they say, an ounce of prevention is worth a pound of cure, and in this case prevention is certainly prudent." (ibid.) Although this type of warning was distributed within Chevron's network, similar warnings were not provided to tank operators who were not Chevron employees but who were receiving Chevron gasoline containing MtBE.

1992 - Amoco Recognizes the Risks of Handling Neat MtBE and MtBE Gasoline

In a series of e-mails beginning in November of 1991, J. G. Huddle of Amoco described the increased threat to ground water posed by neat MtBE and gasoline blended with MtBE (Stamm Deposition, *In re: MtBE Products Liability Litigation,* February 15, 2007, Exhibit 5). Mr. Huddle feared that although attempts had been made to communicate the risks posed by MtBE, "…we have serious doubts that our concerns have been universally understood and accepted." (Bates #BPA00215154). To remedy the situation, the creation of a guideline document for the handling of neat MtBE and MtBE gasoline was proposed.

The resulting document, dated July 1, 1992, was entitled "Guideline for Handling & Storage of Ethers Used in Gasoline" (Stamm deposition, *In re: MtBE Products Liability Litigation,* February 15, 2007, Exhibit #7). This 33 page document provided a thorough description and discussion of the properties of ethers, the health and safety issues associated with ethers, environmental concerns, and compatibility issues. The introduction to the document included this paragraph:

> The purpose of this guideline is to increase awareness of the potential problems in the handling and storing or ethers and gasoline/ether products, and to provide information and recommendations which can be used to avoid these problems or to help deal with them if they occur. Operating procedures and safety precautions will not differ significantly from those currently used for other gasoline products. However, much greater attention must be placed on the increased environmental risks associated with uncontrolled releases of these materials.
>
> -BPA00500903, emphasis added

The document further stated, "Our new blended gasoline products containing ethers will also require increased levels of attention, exceeding that associated with our storage and handling of traditional gasoline products" (Bates #BPA00500906). The emphasis on greater care in handling gasoline containing MtBE was repeated again on the next page, "The avoidance of environmental incidences and serious environmental damage will require a greater vigilance than might be common practice for non-oxygenated gasolines" (Bates #BPA00500907).

Clearly, Amoco Oil was well aware of the environmental hazards posed by MtBE and recognized that extra care would be required in its storage and handling. Amoco based this document on the properties of MtBE (flammability, solubility, low rate of biodegradation) and direct experience cleaning up a MtBE release at one of its terminals. If Amoco Oil could reach these conclusions, then other oil companies, who knew or should have known the same information regarding the physical properties of MtBE, should have come to the same conclusions.

The warnings contained in this document, however, were intended for Amoco personnel. No warnings were provided to marketers or other users of gasoline containing MtBE of the extra care required when handling this product. As Mr. Stamm stated in his deposition:

> In the normal course of operations, separate and distinct warnings for just MTBE are not necessary. The general warnings for gasoline -- handling gasoline and product stewardship of gasoline in general are -- cover all the components within it, including MTBE.
>
> Stamm Deposition, p. 169

In theory, Mr. Stamm's assertion was correct. If absolutely zero gasoline was leaked or spilled, then the MtBE problem would be reasonably controlled. The problem was that the oil marketing industry considered a storage system to be "tight" (that is, "not leaking" and therefore adequate for the storage of gasoline) if it leaked less than 0.1 gallons per hour (875 gallons per year!). The industry's "stewardship" practices generally considered spills of less than a gallon as insignificant. Because traditional gasoline was reasonably biodegradable, the standards for a "tight" storage system and what constituted good "stewardship" were not very stringent. These industry standards and practices were completely inadequate to contain gasoline with MtBE. To adequately contain MtBE gasoline, a storage system would have to leak less than a gallon a year. Good stewardship, when MtBE is involved, means that spills of mere teaspoons must be treated as significant. The addition of MtBE to gasoline required dramatic changes in the concept of a "tight" storage system and the meaning of good stewardship. Unfortunately, these changes were never made.

March 1995 – Public Disclosure of the Extent of MtBE Contamination

In March of 1995, the United States Geological Survey as part of the National Water Quality Assessment Program released a report entitled, "Occurrence of the Gasoline Additive MTBE in Shallow Ground Water in Urban and Agricultural Areas." This report presented the results of sampling of 211 shallow wells in eight urban areas and 524 shallow wells in twenty agricultural areas across the United States. The chemical analyses included 60 volatile organic compounds. Chloroform and MtBE were the two most frequently detected compounds, with MtBE found in 27 percent of the

As this document pointed out, there were many simple things that could have been done to prevent fuel spills and improve the ability of underground storage systems to contain gasoline with MtBE. For the most part, these measures were not implemented by the major oil marketers, nor was this information conveyed to smaller marketers or commercial or government operators of gasoline storage facilities.

What Could Have Been Done to Contain MtBE Gasoline?

Accidents happen. But what happened in the United States in the 1980's and 1990's with regard to the leakage and spillage of gasoline was no accident. It was conscious, callous disregard for human health and the environment. Major oil companies knew very well the condition of the nation's storage systems in the early 1980's. Using oil industry data, Warren Rogers predicted there would be hundreds of thousands of leaks in the mid-1980's. The oil marketing industry then proceeded to transfer liability for many of these releases by selling many thousands of storage systems to unsophisticated, unsuspecting businesspeople. Despite knowledge of the increased risks posed by gasoline with MtBE, major oil refiners chose to blend MtBE into their gasoline, knowing that it would be distributed to storage systems around the country that were in no condition to contain it. It didn't have to be this way.

What could have been done differently? Consider the following:

- Rather than blast the Maine MtBE paper conclusion that MtBE gasoline needed super-secure storage systems as "reactionary, unwarranted, and counterproductive," the API could have acknowledged their members' own experiences with MtBE contamination and communicated to all tank owners the need for storage systems containing MtBE gasoline to be as leak-proof as possible.
- Rather than whitewash the MtBE groundwater issues in the 1988 "Alcohol and Ether" publication, the API could have revealed its members' unpublished information concerning the behavior of MtBE in groundwater.
- Rather than extol only the virtues of MtBE in reducing air pollution, MtBE producers could have also pointed out the threat to groundwater quality that MtBE posed.

- Rather than pointing out that MtBE was safe and versatile, the API in 1996 could also have pointed out that MtBE required extra care in storage and handling.
- Rather than oppose secondary containment as unnecessarily expensive, the MtBE producers could have lobbied regulatory agencies in favor of secondary containment.
- Rather than wait nearly 20 years after the introduction of MtBE, the 1998 WSPA recommendations for improving the storage and handling of MtBE gasoline could have been developed much sooner. Moreover, after they were developed they could have been broadcast more widely and implemented much more vigorously.
- Rather than relying on leak detection techniques that were grossly inadequate to detect MtBE gasoline releases, groundwater monitoring could have been promoted as the leak detection method of choice for MtBE gasoline.

In short, the oil marketing industry could have provided warnings concerning the threat to groundwater posed by MtBE, promoted technologies to more effectively contain MtBE, publicized methodologies that could provide early detection of MtBE releases, and campaigned for improved handling of MtBE gasoline. These measures would not have prevented all incidents of MtBE contamination, but they could have significantly reduced the number and magnitude of MtBE releases.

But taking these steps would have been troublesome and expensive. It would have increased concern among the general public and would likely have caused a number of people to ask whether MtBE was really worth the price. Thus the easy path for the MtBE producers was to maintain silence or actively deny the threat posed by MtBE, cross their fingers, and hope that high profile MtBE incidents would be few and far between. These hopes were dashed by leak incidents such as Santa Monica and Lake Tahoe. The rest is history.

Summary Listing of Opinions Contained in this Report

- The petroleum industry was very well aware that large numbers of underground storage systems were leaking or at risk of leaking when they introduced MtBE as